(2) Drugs Containing Alkaloids

(2-2) INDOLE ALKALOIDS

The indole nucleus is found in a large number of naturally occurring compounds. It is of commercial importance as a component of perfumes.

NUX VOMICA

Biological Source

Nux vomica consists of the dried ripe seeds of *Strychnos nux vomica* Linn, family Loganiaceae.

Chemical Constituents

Alkaloids, Strychnine (1.25%) and **Brucine** (1.5%), also traces of strychnicine, and a glucoside Loganin, about 3% fatty matter, caffeotannic acid and a trace of copper. Strychnine is therapeutically active and toxic alkaloid. Brucine is chemically dimethoxystrychnine and is less toxic and has very little physiological action. It is intensely bitter and is used as a standard for determining the bitter value, of many bitter drugs.

Uses

The properties of nux vomica are substantially those of the alkaloid Strychnine. In the mouth it acts as a bitter, increasing appetite; it stimulates peristalsis, in chronic constipation due to atony of the bowel it is often combined with cascara and other laxatives with good effects.

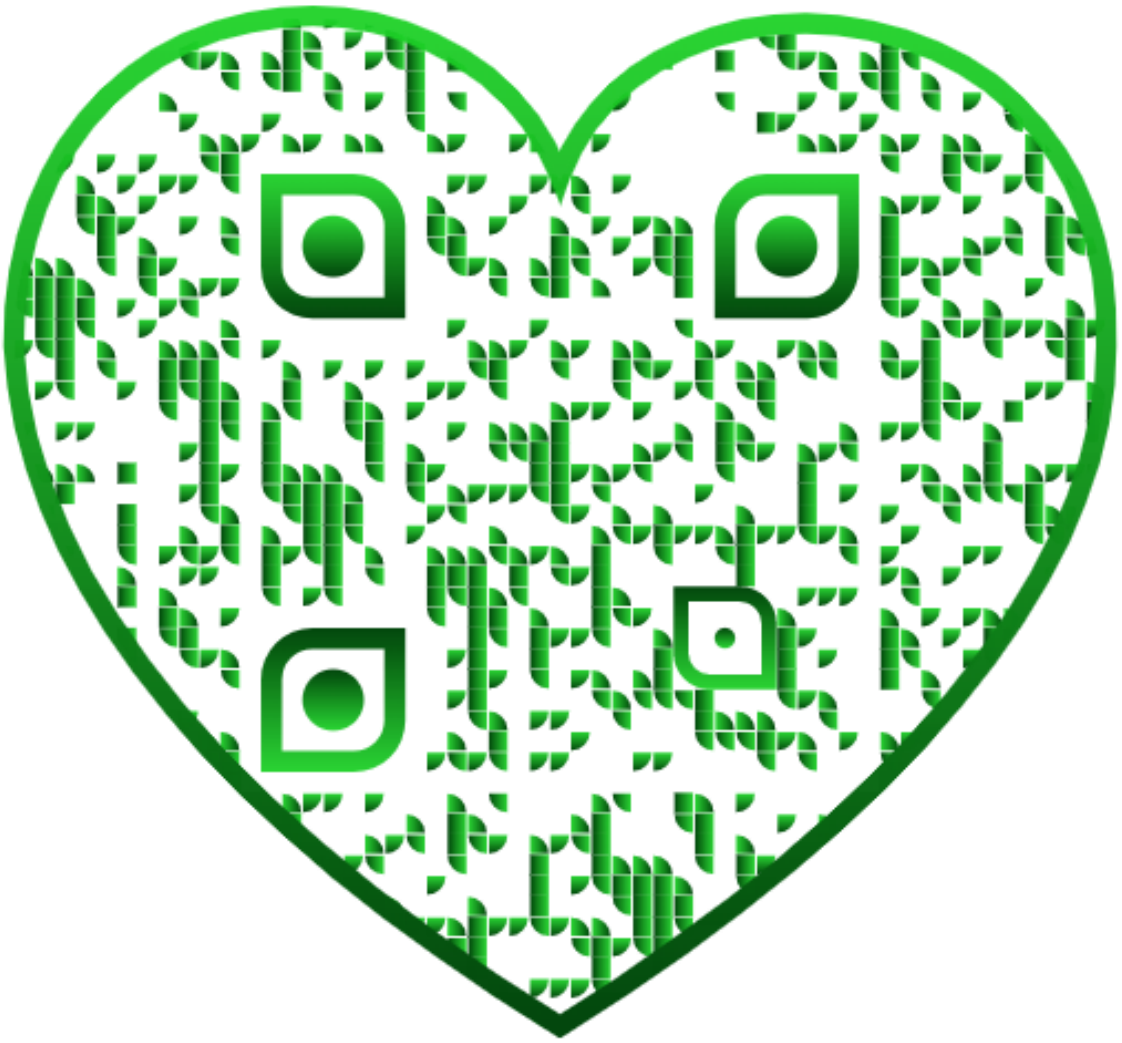
The senses of smell, touch, hearing and vision are rendered more acute, it improves the pulse and raises blood pressure and is of great value as a tonic to the circulatory system in cardiac failure. In toxic doses strychnine causes violent tetanus like convulsions and death takes place due to asphyxia and respiratory failure.

(2-3)PYRIDINE AND PIPERIDINE ALKALOIDS

TOBACCO

Biological Source

It consists of dried leaves of *Nicotiana tobaccum*, - family Solanaceae.



Chemical Constituents

Alkaloids nicotine, nicotianin, nicotinine, nicoteine, nicoteline. After leaves are smoked the nicotine decomposes into pyridine, furfurol, collidine, hydrocyanic acid, carbon monoxide, etc. The poisonous effects of Tobacco smoke are due to these substances of decomposed nicotine.

Uses

Nicotine is very like coniine and lobeline in its pharmacological action, and the pyridines in the smoke modify very slightly its action. It is used as a sedative, diuretic, expectorant, discutient (مبدد) and sialagogue (مدر اللعاب). The leaves in combination with the leaves of belladonna or stramonium make an excellent application for obstinate (مستعصي) ulcers, painful tremors and spasmodic affections. Tobacco leaves are made wet and applied for piles. Externally nicotine is an antiseptic. Nicotine exerts stimulant effects on heart and nervous system.

(2-6) ISOQUINOLINE ALKALOIDS

IPECAC

Biological Source

Ipecac consists of the dried root or rhizome of *Cephaelis ipecacuanha* (Brot.) A. Rich. (Rio or Brazilian Ipecac) or of *Cephaelis acuminata* Karst. family Rubiaceae.

Chemical Constituents

Alkaloids: emetine, cephaeline, psychotrine and psychotrine methyl ether.

Uses

Ipecac is emetic and used as an expectorant and diaphoretic and in the treatment of amoebic dysentery. The alkaloids have local irritant action. Emetine has a more expectorant and less emetic action than cephaeline. In the treatment of amoebic dysentery emetine hydrochloride is given by injection and emetine and bismuth iodide by mouth.

Psychotrine and its methyl ether are selective inhibitors of human immunodeficiency virus.

(2-9) DITERPENE ALKALOIDS

ACONITE

Biological Source

Aconite is the dried roots of *Aconitum napellus* Linn, collected from wild or cultivated plants., belonging to family Ranunculaceae.

Chemical Constituents

Aconite contains aconitine, aconine. The aconitines are diacyl esters of polyhydric amino alcohols and are extremely poisonous. The basic skeleton of aconite alkaloid is consisted of a pentacyclic diterpene.

Uses

It is used externally as a local analgesic in liniments and to treat neuralgia, rheumatism and inflammation. Tincture Aconite is antipyretic in small doses. Aconitine in amount 2–3 mg can lead respiratory failure, heart failure and in the end death. The drug is used for the preparation of an antineuralgic liniment.

(2-10) AMINO ALKALOID

EPHEDRA

Biological Source

Ephedra consists of the dried aerial parts of *Ephedra gerardiana* Wall, *Ephedra sinica* Stapf, *Ephedra equisetina* Bunge, family Ephadreaceae.

Chemical Constituents

Ephedra contains alkaloids Ephedrine (water-soluble salt of an alkaloid), Pseudoephedrine (analog of ephedrine), Norpseudoephedrine (An analog of ephedrine). The leaves and stems of ephedra also contain many potentially active compounds, such as tannins, saponin, flavone and volatile oils.

Uses

Ephedrine is antiallergenic, antiasthmatic, antispasmodic, decongestant, cough suppressant, stimulant and vasoconstrictor. Pseudoephedrine is decongestant, cough suppressant and norpseudoephedrine is peripheral vasodilator used to treat angina.

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(3) Drugs Containing Glycosides

A glycoside is any molecule in which a sugar group is bonded through its anomeric carbon to another group via glycosidic bond.

A glycosidic bond is a certain type of chemical bond that joins a sugar molecule to another molecule.

A substance containing a glycosidic bond is a glycoside. The glycone and aglycone portions can be chemically separated by hydrolysis in the presence of acid.

There are also numerous enzymes that can form and break glycosidic bonds. The sugar group is known as the glycone and the non-sugar group as the aglycone or genin part of the glycoside. The glycone can consist of a single sugar group (monosaccharide) or several sugar groups (oligosaccharide).

The sugars found in glycosides may be glucose and rhamnose (monosaccharides) or, more rarely, deoxysugars such as the cymarose found in cardiac glycosides.

In plants glycosides are both synthesized and hydrolysed under the influence of more or less specific enzymes.

CLASSIFICATION

The glycosides can be classified by the glycone, by the type of glycosidal linkage, and by the aglycone.

On the Basis of Glycone

If the glycone group of a glycoside is glucose, then the molecule is a glucoside; if it is fructose, then the molecule is a fructoside; if it is glucuronic acid, then the molecule is a glucuronide, etc.

On the Basis of Glycosidic Linkage

1. O-glycosides.
2. N-glycosides.
3. S-glycosides.
4. C-glycosides.

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On the Basis of Aglycone

The various classes according to aglycone moiety are given below:

3-2 STEROL OR CARDIAC GLYCOSIDES

The cardiac glycosides are an important class of naturally occurring drugs whose actions include both beneficial and toxic effects on the heart.

Cardiac steroids are widely used in the modern treatment of congestive heart failure and for treatment of atrial fibrillation and flutter (رجفان).

Yet their toxicity remains a serious problem. These drugs all act by affecting the availability of intracellular Ca+2 for myocardial contraction or increasing the sensitivity of myocardial contractile proteins.

The steroid nucleus has a unique set of fused ring system that makes the aglycone moiety structurally distinct from the other more common steroid ring systems. The steroid nucleus has hydroxyls at 3- and 14-positions of which the sugar attachment uses the 3-OH group. 14-OH is normally unsubstituted. Many genins have OH groups at 12- and 16-positions. These additional hydroxyl groups influence the partitioning of the cardiac glycosides into the aqueous media and greatly affect the duration of action. The lactone moiety at C-17 position is an important structural feature.

One to four sugars are found to be present in most cardiac glycosides attached to the 3β-OH group. The sugars most commonly used include L-rhamnose, D-glucose, D-digitoxose, D-digitalose, D-digginose, D-sarmentose, L-vallarose and D-fructose. These sugars predominantly exist in the cardiac glycosides in the β-conformation.

Two classes have been observed in nature—the cardenolides and the bufadienolides.

DIGITALIS LEAVES

Biological Sources

Digitalis consists of dried leaves of *Digitalis purpurea* Linn., belonging to family Scrophulariaceae.

Chemical Constituents

Purpurea glycosides A and B and glucogitoloxin are primary glycosides. Because of greater stability of secondary glycosides, and lesser absorption of primary glycosides a

higher content of primary glycosides are not considered ideal and secondary glycosides are used.

Purpurea glycosides A and B are present in fresh leaves and by their hydrolysis digitoxin and glucose or gitoxin and glucose are obtained respectively.

Uses

The foxglove is a widely used herbal medicine with a recognized stimulatory effect upon the heart. It is also used in allopathic medicine in the treatment of heart complaints. It has a profound tonic effect upon a diseased heart, enabling the heart to beat more slowly, powerfully and regularly without requiring more oxygen. At the same time it stimulates the flow of urine which lowers the volume of the blood and lessens the load on the heart. It has also been employed in the treatment of internal haemorrhage, in inflammatory diseases, in delirium tremens, in epilepsy, in acute mania and various other diseases. Digitalis has a cumulative effect in the body, so the dose has to be decided very carefully.

3-3 SAPONIN GLYCOSIDES

Saponins are glycoside compounds often referred to as a 'natural detergent' because of their foamy texture. They get their name from the soap wort plant (Saponaria). Foremost among this is the strong tendency to froth formation when shaken with water. The other properties are hemolytic activity, sneezing effect, toxicity, complex formation with cholesterol and antibiotic properties.

3-3-1 Steroid Saponins

Steroid saponins are similar to the sapogenins and related to the cardiac glycosides. They have ability to interact medically and beneficially with the cardiac glycosides, sex hormones, Vitamin D and other factors, render these phytochemicals components of great medical significance.

3-3-2 Triterpenenoid Saponins

Triterpenoid saponins, or sapogenins, are plant glycosides which lather in water and are used in detergents, or as foaming agents or emulsifiers, and have enormous medical implications due to their antifungal, antimicrobial, and adaptogenic properties.

Saponins are not poisonous to man when taken orally. Very dilute solution of saponins hemolysis red blood corpuscles. The hemolysis take place due to the formation of complex with the cholesterol of erythrocyte membrane causing its destruction, this is a chief property of saponin, very rarely shown by any other plants product.

LIQUORICE

Biological Source

Liquorice consists of subterranean peeled and unpeeled stolons, roots and subterranean stems of *Glycyrrhiza glabra* Linn, and other species of *Glycytrhiza*, belonging to family Leguminosae.

Chemical Constituents

The chief constituent of liquorice root is Glycyrrhizin (6–8%), obtainable in the form of a sweet, which is 50 times sweeter than sucrose, white crystalline powder, consisting of the calcium and potassium salts of glycynhizic acid. Glycyrrhizic acid on hydrolysis yields glycyrrhetic or glycyrrhetinic acid.

Glycyrrhizinic acid is a triterpenoid saponin having α-amyrine structure. It shows especially in alkaline solution frothing but it has very weak haemolytic property.

The yellow colour of the drug is due to chalcone glycoside isoliquiritin. The drug also contains sugar, starch (29%), gum, protein, fat (0.8%), resin, asparagin (2–4%), a trace of tannin in the outer bark of the root, yellow colouring matter, and 0.03% of volatile oil.

Uses

Glycyrrhiza is widely used as a sweetening agent and in bronchial problems such as catarrah, bronchitis, cold, flu and coughs. It reduces irritation of the throat and yet has an expectorant action. It produces its demulcent and expectorant effects. It is used in relieving stress. It is a potent healing agent for tuberculosis, where its effects have been compared to hydrocortisone. Glycyrrhiza is also effective in helping to reduce fevers

(glycyrretinic acid has an effect like aspirin), and it may have an antibacterial action as well. It is used in the treatment of chronic inflammations such as arthritis and rheumatic diseases, chronic skin conditions, and autoimmune diseases in general. It should be used in moderation and should not be prescribed for pregnant women or people with high blood pressure, kidney disease or taking digoxin-based medication. Prolonged usage raises the blood pressure and causes water retention. Externally, the root is used in the treatment of herpes, eczema and shingles.

3-4 CYANOGENIC GLYCOSIDES

These are the glycosides which on hydrolysis yields hydrocynic acid (HCN), benzaldehyde and sugars. The medicinal activity of cyanogenetic glycosides is due to presence of hydrocyanic acid. For examples Amygdalin obtained from bitter almond (*Prunus amygdalus*.

ALMOND

Biological Source

Almond oil is a fixed oil obtained by expression from the seeds of *Prunus amygdalus* (Rosaceae) var. dulcis (sweet almonds), or *P. amygdalus* var. amara (bitter almonds).

Chemical Constituents:

Both varieties of almond contain 40–55% of fixed oil, about 20% of proteins, mucilage and emulsin. The bitter almonds contain in addition 2.5–4.0% of the colourless, crystalline, cyanogenelic glycoside amygdalin, Essential or volatile oil of almonds is obtained

Uses

Expressed almond oil is an emollient and an ingredient in cosmetics. Almond oil is used as a laxative, emollient, in the preparation of toilet articles and as a vehicle for oily injections. The volatile almond oils are used as flavouring agents.

3-6 FLAVONE GLYCOSIDES

These are complex organic compounds containing phenylbenzopyrone ring system. Flavones are present in plants in a free state or in glycosidal state (O-glycoside or C-glycoside) with its different derivatives like flavane, flavonol, flavonone, isoflavone and

chalcones, for example, Rutin, quercitrin, hyperoside, diosmin (buchu leaf), hesperidin (lemon and orange peel) and vitexin (Carategus).

GINKGO

Biological Source

The leaves of Ginkgo are obtained from the dioeceous tree *Ginkgo biloba*, belonging to family Ginkgoaceae.

Chemical Constituents

The diterpene lactones and flavonoids possess therapeutic activity. Five diterpene lactones (ginkgolides A, B, C, J, M) have been characterized. These compounds are plateletactivating factor (PAF) antagonists and as they do not react with any other known receptor, their effect is very specific.

Uses

Ginkgo is used as an antiasthmatic and bronchodilator. Extracts of the leaf containing selected constituents are used for improving peripheral and cerebral circulation in those elderly with symptoms of loss of short-term memory, hearing and concentration; it is also claimed that vertigo, headaches, anxiety and apathy are cured.

3-9 PHENOL GLYCOSIDES

BEARBERRY

Biological Source

These are the dried leaves of *Arctostaphylous uva-ursi* (Linne) Sprengel, belonging to family Ericaceae.

Chemical Constituents

The leaves contain a glycoside called arbutin which contains phenolic aglycone. The leaves also contain methyl arbutin, quercetin, ursone, iriodoids, quinones, tannins (6–10%), gallic acid ursolic acid, α-amyrin, β-amyrin and terpenoids.

Uses

The leaves have diuretic and astringent properties. As an infusion, it is used in urethritis and cystitis.

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3-11 BITTER AND MISCELLANEOUS GLYCOSIDES

Bitter glycosides are a class of compounds that plays an important role in the digestive process.

The bitterness of food on the tongue plays a very important role as the taste of bitter foods stimulates the appetite and triggers the secretion of digestive juices in the stomach, which in turn improves the break down of food.

Bitters begin by stimulating the taste buds. This triggers off a reflex nerve action which increases the flow of saliva and stomach enzymes. At the same time, the hormone gastrin is secreted by the walls of the stomach. This improves the digestive process, by improving the passage of food from the stomach to the intestines. The sum total of this is an improvement in the digestive function of the stomach and small intestines. Bitters can also be very useful to improve immune disorders resulting from food intolerance or dietary antigen leakage, protect gut tissue, promote bile flow and enhance pancreatic function.

Bitter drugs preparations should be taken before or during meals otherwise they cause digestive disturbances like diarrhoea, and pain in the stomach.

GENTIAN

Biological Source

Gentian consists of dried unfermented rhizomes and roots of *Gentiana lutea* Linn., belonging to family Gentianaceae.

Chemical Constituents

Gentian contains bitter glycosides. The dried gentian root contains Gentinin and Gentiamarin, bitter glucosides, together with Gentianic acid (gentisin), the latter being physiologically inactive. Gentiopicrin, another bitter glucoside

Uses

Gentian root has a long history of use as an herbal bitter in the treatment of digestive disorders. It is useful in states of exhaustion from chronic disease and in all cases of debility, weakness of the digestive system and lack of appetite.

It is one of the best strengthened of the human system, stimulating the liver, gall bladder and digestive system, and is an excellent tonic to combine with a purgative in order to prevent its debilitating effects.

It is also used as anthelmintic, antiinflammatory, antiseptic, bitter tonic, cholagogue, emmenagogue, and febrifuge, refrigerant and stomachic. It is taken internally in the treatment of liver complaints, indigestion, gastric infections and anorexia. It should not be prescribed for patients with gastric or duodenal ulcers.

(4) Drugs Containing Volatile Oils

Volatile oils are odorous volatile principles of plant and animal source, evaporate when exposed to air at ordinary temperature, and hence known as volatile or etheral oils.

These represent essence of active constituents of the plant and hence also known as essential oils.

TERPENOIDS

There are many different classes of naturally occurring compounds. Terpenoids also form a group of naturally occurring compounds majority of which occur in plants, a few of them have also been obtained from other sources.

Terpenoids are volatile substances which give plants and flowers their fragrance. The simpler mono and sesquiterpenes is the chief constituent of the essential oils obtained from sap and tissues of certain plant and trees. The di- and triterpenoids are not steam volatile. They are obtained from plant and tree gums and resins. Tertraterpenoids form a separate group of compounds called ‘Carotenoids’.

CLASSIFICATION OF TERPENOIDS

Most natural terpenoid hydrocarbons have the general formula $(C_5H_8)_n$. They can be classified on the basis of number of carbon atoms present in the structure. Each class can be further subdivided into subclasses according to the number of rings present in the structure.

1. Acyclic Terpenoids: They contain open structure.
2. Monocyclic Terpenoids: They contain one ring in the structure.
3. Bicyclic Terpenoids: They contain two rings in the structure.

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4. Tricyclic Terpenoids: They contain three rings in the structure.

5. Tetracyclic Terpenoids: They contain four rings in the structure.

PHARMACEUTICAL APPLICATIONS

Volatile oils are used as flavouring agent, perfuming agent in pharmaceutical formulations, foods, beverages, and in cosmetic industries. These are also used as important medicinal agent for therapeutic purposes like:

1. Carminative (e.g. Umbilliferous fruits)
2. Anthelminitic (e.g. Chenopodium oil)
3. Diuretics (e.g. Juniper)
4. Antiseptic (e.g. Eucalyptus)
5. Counter irritant (e.g. Oil of winter green)
6. Local anesthetic (e.g. Clove)
7. Sedative (e.g. Jatamansi)
8. Local irritant (e.g. Turpentine)
9. Insect repellent (e.g. Citronella)
10. Source of vitamin A (e.g. Lemongrass)

4-2 VOLATILE OILS CONTAINING ALCOHOLS

PEPPERMINT

Botanical Source

It is the oil obtained by the distillation of *Mentha piperita*, belonging to family Labiatae.

Chemical Constituents

The chief constituent of Peppermint oil is Menthol, along with other constituents like menthyl acetate, isovalerate, menthone, cineol, inactive pinene, limonene, and other less important bodies.

Uses

It is stimulant, stomachic, carminative, inflatulence, and colic; in some dyspepsia, sudden pains, for cramp in the abdomen and also in cholera and diarrhoea. Oil of peppermint allays sickness and nausea, as infants cordial.

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Peppermint is good to aid in raising internal heat and inducing perspiration. It is also used in cases of hysteria and nervous disorders.

4-3 VOLATILE OILS CONTAINING ALDEHYDES

LEMON PEEL

Biological Source

Lemon peel is obtained from the fresh ripe fruit of *Citrus limon* (L.) Burm. f. (C *medico* var. *limon* Linn.), belonging to family Rutaceae.

Chemical Constituents

Lemon peel contains volatile oil (2.5%), vitamin C, hesperidin and other flavone glycosides, mucilage, pectin and calcium oxalate. The important constituents of the volatile oil are limonene (90%), citronellal, geranyl acetate, α-pinene, camphene, linalool, terpineol, methyl heptenone, octyl and nonyl aldehydes, γ-terpinene, β-pinene, neral, and geranial.

Uses

Lemon peel is used as a flavouring agent, perfumery, stomachic, and carminative. The oil, externally, is a strong rubefacient and if taken internally in small doses has stimulating and carminative properties.

4-5 VOLATILE OIL CONTAINING PHENOL

CLOVE

Biological Source

Clove consists of the dried flower buds of *Eugenia caryophyllus* Thumb., belonging to family Myrtaceae.

Chemical Constituents

Clove contains 14–21% of volatile oil. The other constituents present are the eugenol, acetyl eugenol, gallotannic acid, and two crystalline principles; α- and β-caryophyllenes, methyl furfural, gum, resin, and fibre. Caryophyllin is odourless component and appears to be a phytosterol, whereas eugenol is a colourless liquid. Clove oil has 60–90% eugenol, which is the cause of its anesthetic and antiseptic properties.

Uses

Clove is used as an antiseptic, stimulant, carminative, aromatic, and as a flavouring agent. It is also used as anodyne, antiemetic. Dentists use clove oil as an oral anesthetic and to disinfect the root canals. Clove kills intestinal parasites and exhibits broad antimicrobial properties against fungi and bacteria and so it is used in the treatment of diarrhea, intestinal worms, and other digestive ailments. Clove oil can stop toothache. A few drops of the oil in water will stop vomiting, eating cloves is said to be aphrodisiac. Eugenol is also used as local anaesthetic in small doses. The oil stimulates peristalsis; it is a strong germicide, also a stimulating expectorant in bronchial problems. The infusion and Clove water are good vehicles for alkalies and aromatics.

4-8 VOLATILE OIL CONTAINING ESTER

GARLIC

Biological Source

Garlic is the ripe bulb of *Allium sativum* Linn., belonging to family Liliaceae.

Chemical Constituents

Allicin, a yellow liquid responsible for the odour of garlic, is the active principle of the drug. It is miscible with alcohol, ether, and benzene and decomposes on distilling. The other constituents reported in Garlic are alliin, volatile and fatty oils, mucilage and albumin. Alliin, another active principle. Essential oil (0.06–0.1%) contains allyl propyl disulphide, diallyl disulphide, and allicin. γ-Glutamyl peptides are isolated from the Garlic. The amino acids present in the bulb are leucine, methionine, S-propyl-L-cysteine, S-propenyl-Lcysteine, S-methyl cysteine, S-allyl cysteine sulphoxide (alliin), S-ethyl cysteine sulphoxide, and S-butyl-cysteine sulphoxide.

Uses

Garlic is carminative, aphrodisiac, expectorant, stimulant, and used in fevers, coughs, febrifuge in intermittent fevers, respiratory diseases such as chronic bronchitis, bronchial asthma, whooping cough, and tuberculosis. It is also used in atherosclerosis and hypertension.

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Garlic or its constituents exhibit various biological activities, such as antibacterial, antifungal, antiviral, antitumor, and antidiabetic effects.

(5) Drugs Containing Resins

Resin can be defined as the complex amorphous product of more or less solid characteristics which on heating first sets softened and then melt.

CLASSIFICATION

Resins are classified mostly on the basis of two important features, that is, on the basis of their chemical nature and secondly as per their association with the other group of compounds like essential oils and gums.

Chemical classification of resins categorizes these products according to their active functional groups as given below:

5-1 Resin Acids

The abietic acid and commiphoric acid present in colophony and myrrh respectively are the examples of resin acids.

5-2 Resin Esters

Dragon's blood and benzoin are the common resin ester containing drugs.

5-3 Resin Alcohols

Resinols are present in benzoin as benzoresinol and in storax as storesinol.

5-4 Resin Phenols

The resinotannol are found in balsam of Peru as peruresinotannol, in Tolu balsam as toluresinotannol and in benzoin as siaresinotannols.

5-5 Glucoresins

Resins sometimes get combined with sugars by glycosylation and produce glucoresins. Glycoresins can be hydrolysed by acidic hydrolysis to the glycone and aglycone.

5-6 Resenes

Chemically inert resin products are generally termed as resenes. They are generally found in free state and never form esters or other derivatives. Asafoetida is an example of resene-containing drug.

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5-7 Oleoresins

Oleoresins are the homogenous mixture of resin with volatile oils. Turpentine, ginger, copaiba, Canada resin are few important examples of oleoresins.

5-8 Gum Resins

Gum resins are the naturally occurring mixture of resins with gums. Due to solubility in water, gums can be easily separated out from resin by dissolving the gum in water. Ammoniacum is an example of natural gum resin.

5-9 Oleogum Resins

Oleogum resins are the naturally occurring mixtures of resin, volatile oil, and gum. The example includes gum myrrh, asafoetida, gamboage, etc.

5-10 Balsams

Balsams are the naturally occurring resinous mixtures which contain a high proportion of aromatic balsamic acids such as benzoic acid, cinnamic acid, and their esters. Some important balsams containing drugs are balsam of Peru, balsam of Tolu, benzoin, and storax.

CHEMICAL COMPOSITION

The chemical composition of the resin is generally quite complex and diverse in its nature. It can be a complex mixture of acids, alcohols, phenols, esters, glycosides, or hydrocarbons. When the resins are associated with volatile oils, contains the components like monoterpenoids, sesquiterpenonoids, and diterpenoids. The gums which are associated with resins are similar to acacia gum which sometimes possesses smaller quantities of oxidase enzymes. Resins can be of the physiological origin such as the secretions of the ducts. They can also be pathological products which are exuded through the incisions made on the plant.

PODOPHYLLUM

Biological Source

Podophyllum consists of the dried rhizomes and roots of *Podophyllumpeltatum* Linn., belonging to family Berberidaceae.

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Chemical Constituents

Podophyllum rhizomes contain 2–8% resinous material termed as podophyllin. The major constituents of podophyllum resin are the lignan derivatives which are characterized as podophyllotoxin, α- and β-peltatin.

Uses

Podophyllum resin or podophyllin shows cytotoxic activity. It is used for the treatment of venereal and other warts. Podophyllotoxin is semisynthetically converted to a potent anticancer agent etoposide which is mainly used for the treatment of lung and testicular cancer. Podophyllum resin is a strong gastrointestinal irritant. It acts as a drastic purgative in moderate doses but it has been mostly replaced by other purgative drugs.

(6) Drugs Containing Lipids

The lipids are a large and diverse group of naturally occurring organic compounds that are related by their solubility in nonpolar organic solvents (e.g. ether, chloroform, acetone, and benzene) and are generally insoluble in water. There is great structural variety among the lipids and comprise of fixed oils, fats, and waxes.

The lipids of physiological importance for humans have the following major functions:

1. They serve as structural components of biological membranes.
2. They provide energy reserves, predominantly in the form of triacylglycerols.
3. Both lipids and lipid derivatives serve as vitamins and hormones.
4. Lipophilic bile acids aid in lipid solubilization.

6-1 FIXED OILS AND FATS

Fixed oils and fats are obtained from plants or animal. If a substance is liquid at 15.5–16.5°C it is called fixed oil and solid or semisolid at the above temperature, it is called fat. They are made from two kinds of molecules: glycerol (a type of alcohol with a hydroxyl group on each of its three carbons) and three fatty acids joined by dehydration synthesis. Since there are three fatty acids attached, these are known as triglycerides. These fatty acids may be saturated, monounsaturated or polyunsaturated.

Fixed oils and fats are insoluble in water and alcohol and are soluble in lipid solvents like light petroleum, ether, chloroform, and benzene. Only exception in this solubility is

castor oil that is soluble in alcohol because of its hydroxy group of ricinoleic acid. They float in water since their specific gravity is less than one. They produce a permanent translucent stain on the paper and are called fixed oils. Fixed oils and fats cannot be distilled without their decomposition.

6-2 WAXES

Waxes are esters of long-chain fatty acids and alcohols. The fatty acids are same in wax and fats, but the difference being saponification. Waxes are saponified only by alcoholic alkali but the fats may be saponified either by alcoholic alkali or by aqueous alkali.

Waxes are widely distributed in nature. The leaves and fruits of many plants have waxy coatings, which may protect them from dehydration and small predators. The feathers of birds and the fur of some animals have similar coatings which serve as a water repellent. Spermaceti, beeswax, carnuba wax, etc. are the examples of waxes.

COD LIVER OIL

Biological Source

It is processed from fresh liver of cod fish, *Gadus morrhua* and other species of Gadus, belonging to family Gadidae.

Chemical Constituents

The cod liver oil contains glycerides esters of saturated acids of linoleic, oleic, myristic, gadoleic, palmitic, and other acids. The oil has vitamin A and vitamin D. Cod liver oil also contains about 1% unsaponifiable matter; like cholesterol, fatty alcohol, squalene, α-glyceryl esters, etc.

Uses

Oil is used as source of vitamins, in treatment of rickets, tuberculosis, and also as a nutritive.

BEESWAX

Biological Source

Beeswax is the purified wax obtained from honeycomb of hive bee, *Apis mellifera* Linn and other species of Apis, belonging to family Apidae.

Chemical Constituents

Beeswax contains myricin, which is melissyl palmitate; melting point 64°C, free cerotic acid ($C_{26}H_{52}O_2$), myricyl alcohol ($C_{30}H_{61}OH$) is liberated when myricyl palmitate is saponified. Melissic acid, some unsaturated acids of the oleic series, ceryl alcohol, and 12 to 13% higher hydrocarbons are present.

Uses

Beeswax is used in the preparation of ointments, plaster, and polishes.

(7) Drugs Containing Tannins

The name 'tannin' is derived from the French 'tanin' (tanning substance) and is used for a range of natural polyphenols. Tannins are complex organic, nonnitrogenous plant products, which generally have astringent properties. The term 'tannin' was first used by Seguin in 1796 to denote substances which have the ability to combine with animal hides to convert them into leather which is known as tanning of the hide. According to this, tannins are substances which are detected by a tanning test due to its absorption on standard hide powder. The test is known as Goldbeater's skin test.

CLASSIFICATION

The tannin compounds can be divided into two major groups on the basis of Goldbeater's skin test. A group of tannins showing the positive tanning test may be regarded as true tannins, whereas those, which are partly retained by the hide powder and fail to give the test, are called as pseudotannins.

Most of the true tannins are high molecular weight compounds. These compounds are complex polyphenolics, which are produced by polymerization of simple polyphenols. They may form complex glycosides or remains as such which may be observed by their typical hydrolytic reaction with the mineral acids and enzymes.

Two major chemical classes of tannins are usually recognized based on this hydrolytic reaction and nature of phenolic nuclei involved in the tannins structure. The first class is referred to as hydrolysable tannins, whereas the other class is termed as condensed tannins.

7-1 Hydrolysable Tannins

As the name implies, these tannins are hydrolysable by mineral acids or enzymes such as tannase. Their structures involve several molecules of polyphenolic acids such as gallic, hexahydrodiphenic, or ellagic acids, bounded through ester linkages to a central glucose molecule.

The hydrolysable tannins are soluble in water, and their solution produces blue colour with ferric chloride.

7-2 Nonhydrolysable or Condensed Tannins

Condensed tannins, unlike the previously explained group are not readily hydrolysable to simpler molecules with mineral acids and enzymes, thus they are also referred to as nonhydrolysable tannins. The term proanthocyanidins is sometimes alternatively used for these tannins. The compounds containing condensed tannins contain only phenolic nuclei which are biosynthetically related to flavonoids.

7-3 Pseudotannins

Pseudotannins are simple phenolic compounds of lower molecular weight. They do not respond to the tanning reaction of Goldbeater's skin test. Gallic acid, Chlorogenic acid, or the simple phenolics such as catechin are pseudotannins which are abundantly found in plants, especially in dead tissues and dying cells.

MEDICINAL PROPERTIES AND USES

Tannins are medicinally significant due to their astringent properties. They promote rapid healing and the formation of new tissues on wounds and inflamed mucosa. Tannins are used in the treatment of varicose ulcers, haemorrhoids, minor burns, frostbite, as well as inflammation of gums.

Internally tannins are administered in cases of diarrhoea, intestinal catarrh, and in cases of heavy metal poisoning as an antidote. In recent years, these compounds have demonstrated their antiviral activities for treatment of viral diseases including AIDS. Tannins are used as mordant in dyeing, manufacture of ink, sizing paper and silk, and for printing fabrics. It is used along with gelatine and albumin for manufacture of

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imitation horn and tortoise shell. They are widely used in the leather industry for conversion of hide into leather, the process being known as tanning.

Tannins are also used for clarifying beer or wine, in photography or as a coagulant in rubber manufacture. Tannins are used for the manufacture of gallic acid and pyrogallol, and sometimes as a reagent in analytical chemistry.

HYDROLYSABLE TANNINS

NUTGALLS

Biological Source

Nutgall consists of the pathological outgrowth obtained from the young twigs of the dyers oak, *Quercus infectoria* Olivier, belonging to family Fagaceae. Outgrowth is caused by the puncture of ovums of insect *Cynips tinctoria* or *Adleria gallaetinctoriae* Olivier Family Cynipidae.

Chemical Constituents

Nutgalls contains about 50–70% tannin mainly gallotannic acid and tannic acid of commerce is a hydrolysable tannin which yields gallic acid and glucose. The molecule of tannic acid may contain the gallic acid up to pentagalloyl glucose.

Uses

Nutgall is the major source of tannic acid, which is largely used in tanning and dyeing industry and for the manufacture of ink. It is used medicinally as a local astringent in ointments and suppositories.

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